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(54) Method for producing polypropylene resin article having skin material lined with foamed layer

Verfahren zur Herstellung von Polypropylengegenständen mit Häuten und Schaumschicht

Procédé de production d'article en polypropylène revêtu d'une feuille mince et de mousse

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- **PATENT ABSTRACTS OF JAPAN vol. 014, no. 311 (M-994) 04 July 1990;& JP A 02 103108 (TOKYO SHEAT KK) 16 April 1990;& WORLD PATENTS INDEX LATEST Section Ch, Week 9021, Derwent Publications Ltd., London, GB; Class A, AN 90 160692.**

EP 0 480 456 B1

Description

The present invention relates to a method for producing a polypropylene resin article having a laminated skin material which is lined with a foamed layer.

Because of low cost, light weight, good decoration effects and feeling, a multi-layer molded article comprising a polypropylene resin body and a skin material which is laminated thereon is widely used in various industrial fields including automobile and appliance industries.

Recently, demand for light weight parts increases in particular in the automobile industry. Therefore, it is highly desired to produce a multi-layer molded article comprising a polypropylene resin body and a skin material which has good feeling and also has a body resin with a light weight.

When a skin material which is lined with a foamed layer is used, by the conventional molding method, the foamed layer tends to be partly damaged by pressure and heat during supply of the resin melt or the multi-layer molded article tends to have uneven surfaces, if the foamed layer has a large expansion ratio or low heat and pressure resistance.

JP-A-210 31 08 describes a method for producing a moulding having a skin without distortion in which a moulding with a skin, a pillar of a car, is injection-moulded by placing a skin consisting of a polyvinyl chloride resin sheet and urethane foam sheet in a female mould having a shape corresponding to the pillar, clamping the female mould and a male mould, injecting plasticised polypropylene resin to a space formed by a cavity and an injection plunger, filling the cavity with resin stored in the space at 160-200 °C, 30-100 kg/cm^2, and a process to release a moulding from the moulds.

An object of the present invention is to provide a novel method for producing a multi-layer molded article comprising a polypropylene resin body and a skin material lined with a foamed layer.

According to the present invention, there is provided a method for producing a multi-layer molded article comprising a polypropylene resin body and a skin material lined with a foamed layer, which method comprises steps of:

providing a pair of upper and lower molds (1,2)

placing a skin material (7) lined with a foamed layer on said lower mold, the foamed layer contacting the surface of said lower mold

supplying a molten polypropylene resin and engaging said molds

the method being characterized by the steps of

providing a pair of upper and lower molds (1,2) which are slidably moveable at an engaged part (6) and in which a cavity clearance (t) can be freely set

placing a skin material (7) lined with a foamed layer between said upper and lower molds and supplying a molten polypropylene resin containing a chemical blowing agent through a resin melt conduit which is provided in said lower mold when said cavity clearance (t) is between (C + 15) mm and (C + 50) mm where "C" is the thickness of said skin material lined with the foamed layer,

lowering said upper mold (1) at a rate of from 10 mm/sec. to 100 mm/sec. and pressing said molten resin at a pressure of from 5 kg/cm^2 to 100 kg/cm^2 to fill the cavity ends with said molten resin to complete molding of a body of said resin,

pressing said body for 1 to 30 seconds after completing molding to form a skin layer at the part of the resin melt contacting the molds,

then, lifting up said upper mold 1 to decrease the compression pressure of said skin material lined with the foamed layer to a pressure lower than the blowing pressure of said polypropylene resin to blow the inner part of the resin melt mass to form and solidify a foamed body, and

again lowering said upper mold (1) to apply a pressure of from 1 kg/cm^2 to 20 kg/cm^2 on the molded article and cooling said article in said molds.

Fig. 1 illustrates the change of the cavity clearance (t) in the molding steps according to the present invention,

Figs. 2 to 5 are cross sections of a pair of upper and lower molds in various steps of the method of the present invention, and

Fig. 6 is a box-shape article produced by the method of the present invention.

Now, the present invention will be explained by making reference to the accompanying drawings.

Figs. 2 to 5 show cross sections of a mold to be used in the method of the present invention, which comprises an upper mold 1 which is vertically moved and a lower mold 2 which is fixed. The lower mold 2 has a resin melt conduit 3 therein, one end 4 of which is connected to a resin supplier (not shown).

Fig. 2 shows the upper and lower molds 1,2 when they are closed to form a cavity 5. The molds are slidably engaged at a part 6 and a distance between the upper and lower molds at an engaging part 6 is so small that the resin melt is not squeezed out through this part. The cavity clearance (t) can be freely set by vertically moving the upper mold 1.

In the Figures, numeral 7 stands for a skin material lined with a foamed layer.

Fig. 1 illustrates the molding steps of one embodiment of the method of the present invention, in which the vertical axis represents the cavity clearance (t) and the horizontal axis represents the time during the molding.

One embodiment of the method of the present invention will be explained by making reference to Fig. 1.

First, the skin material 7 lined with the foamed layer is placed on the lower mold 6, and the upper mold 1 is lowered from the point A to the point B in Fig. 1. At the point B, the clearance (t) is between (C + 15) mm and (C + 50) mm where "C" is the total thickness of the skin material including the foamed layer. Then, a polypropylene resin melt containing a chemical blowing agent which resin forms an article body is supplied through the resin melt conduit 3 into the cavity 5 (between the points B and C in Fig. 1).

Insofar as the clearance (t) is in the above range, the polypropylene resin melt can be supplied while the upper mold is stopped or lowered.

Fig. 4 shows the cross section of the molds when the supply of the resin melt is completed (the point C in Fig. 1).

Since the cavity clearance is selected in the above range, the foamed layer which lines the skin material is not damaged by the pressure and heat.

Second, the upper mold 1 is lowered at a rate of 10 to 100 mm/sec., and the resin melt is pressurized at pressure of from 5 kg/cm^2 to 100 kg/cm^2 to fill the cavity ends with the molten resin to complete molding of a body of the resin (between the points C and D in Fig. 1).

Since The polypropylene resin melt is molded under the above conditions, the skin material and the foamed layer are not damaged, the resin melt flows to the cavity ends and is molded, and further the blowing of the resin melt is suppressed.

Third, the resin is pressed for 1 to 30 seconds after completing of resin molding to form a skin layer (between the points D and E in Fig. 1). A time between the points D and E is selected so that a part of the resin melt which contacts the mold is cooled and solidified while a center part of the resin melt mass is not solidified and can be blown. An actual time vary with a thickness of the molded article and an expansion ratio.

Then, the upper mold 1 is lifted up (between the points E and F) to decrease a compression pressure of the skin material lined with the foamed layer to a pressure lower than a blowing pressure of the polypropylene resin to blow the core part of the resin melt mass, whereby an article body is formed and solidified (between the points F and G in Fig. 1).

The upper mold (1) is again lowered to apply a pressure of from 1 kg/cm^2 to 20 kg/cm^2 on the molded article and the article is cooled in the molds to complete the production of the multi-layer molded article (between the points G and H in Fig. 1). Fig. 5 shows the molds at this point H.

Finally, the molds are opened (between the points H and I in Fig. 1) to recover the molded article having the foamed resin body and the skin material which is laminated on the resin body as shown in Fig. 6.

Since the molded article according to the present invention has, on a surface, the skin material lined with the foamed layer which are not damaged and the skin material has the lined foamed layer, the article has a soft feeling and good appearance. In addition, a surface having no skin material has an unfoamed smooth skin layer with gloss. Therefore, the both surfaces of the molded article have good appearance. Since the resin body is foamed, the whole article is light.

Preferred examples of the skin material are a sheet or leather of polyvinyl chloride, a leather or sheet of a thermoplastic elastomer, woven or non-woven fabrics.

Preferred examples of the foamed layer for lining are a foamed sheet of crosslinked polypropylene or a polyurethane foam sheet. The skin material and the foam sheet are banded with an adhesive or extrusion lamination.

The polypropylene resin includes not only a homopolymer of propylene but also a copolymer of propylene with at least one other comonomer such as ethylene.

Further, the polypropylene resin may contain other resin such as polyethylene or a thermoplastic elastomer, or a filler such as calcium carbonate or talc. However, the content of the polypropylene resin should be at least 50 % by weight in a composition.

As the chemical blowing agent to be used in the method of the present invention, any of chemical blowing agents which are conventionally used to blow the polypropylene resin may be used. Examples of the chemical blowing agent are inorganic blowing agents (e.g. sodium bicarbonate) and organic blowing agents (e.g. azodicarbonamide).

The present invention will be illustrated by the following Examples.

Example 1

As a molding resin, polypropylene (Sumitomo Noblen (trademark) BPZ 5077 manufactured by Sumitomo Chemical Co., Ltd.) containing 3 % by weight of an inorganic blowing agent (Cellmike MB 3062 manufactured by Sankyo Chemical Co., Ltd.) was used. As a skin material lined with a foamed layer, a laminate sheet made of a polyvinyl chloride sheet having a thickness of 0.6 mm lined with a polypropylene foam sheet having a thickness of 3.0 mm (an expansion rate of 15) was used (a total thickness of 3.6 mm).

The mold had a cavity for molding a box-shape article of Fig. 6 having a length of 300 mm, a width of 250 mm and a height of 70 mm. The article was molded in the following steps.

First step

The skin material lined with the foamed layer was placed between the upper mold kept at 30°C and the lower mold kept at 80°C, and the upper mold was lowered to the cavity clearance (t) of 30 mm. Then, a polypropylene resin melt heated at 190°C was supplied through the resin melt conduit in the lower mold (between the points B and C in Fig. 1).

Second step

As soon as the resin melt supply was finished, the upper mold 1 was lowered at a rate of 20 mm/sec. to press the resin melt under pressure of 60 kg/cm^2 for 2 seconds to the mold (between the points C and D in Fig. 1).

Third step

The resin melt was further pressed under pressure of 60 kg/cm^2 for 5 seconds to form a skin layer (between the points D and E in Fig. 1).

Fourth step

The upper mold 1 was lifted up by 3.0 mm (between the points E and F in Fig. 1) to blow and solidify a core (body) part for 30 seconds (between the points F and G in Fig. 1). Thereafter, the molded article was kept cooled under pressure of 10 kg/cm^2 for 30 seconds (between the points G and H in Fig. 1).

The molded article had an expansion ratio of 1.2 and consisted of the body part having a thickness of 2 mm and the skin material lined with the foamed layer having a thickess of 3 mm. The molded article had very good appearance on both surfaces.

Comparative Example 1

In the same manner as in Example 1 except that the polypropylene resin contained no blowing agent, a multi-layer molded article was produced. The article was not foamed and in addition the surfaces were uneven.

Example 2

As a molding resin, polypropylene (Sumitomo Noblen (trademark) AX 568, MFR 65 manufactured by Sumitomo Chemical Co., Ltd.) containing 2 % by weight of an azodicarbonamide blowing agent (Cellmike MB 3013 manufactured by Sankyo Chemical Co., Ltd.) was used. The same molds as used in Example 1 were used. As a skin material lined with a foamed layer, a laminate sheet made of a tricot (woven fabric) having a thickness of 2 mm to which a polyurethane foam sheet having a thickness of 10 mm (an expansion rate of 16) was adhered was used.

The article was molded in the following steps.

First step

The skin material lined with the foamed layer was placed between the upper mold kept at 30°C and the lower mold kept at 50°C and the upper mold was lowered to the cavity clearance (t) of 45 mm. Then, a polypropylene resin melt heated at 200°C was supplied through the resin melt conduit in the lower mold (between the points B and C in Fig. 1).

Second step

As soon as the resin melt supply was finished, the upper mold 1 was lowered at a rate of 20 mm/sec. to press the resin melt under pressure of 30 kg/cm^2 for 2 seconds to the mold (between the points C and D in Fig. 1).

Third step

The resin melt was further pressed under pressure of 30 kg/cm^2 for 5 seconds to form a skin layer (between the points D and E in Fig. 1).

Fourth step

The upper mold 1 was lifted up by 12.0 mm (between the points E and F in Fig. 1) to blow and solidify a core (body) part for 30 seconds (between the points F and G in Fig. 1). Thereafter, the molded article was kept cooled under pressure of 15 kg/cm^2 for 40 seconds (between the points G and H in Fig. 1).

The molded article had an expansion ratio of 1.3 and a thickness of 3 mm at a bottom part of the box, and was laminated with the skin material lined with the foamed layer having a thickness of 10 mm. The molded article had very good appearance on both surfaces as in Example 1.

Comparative Example 2

In the same manner as in Example 2 except that the polypropylene resin contained no blowing agent, a multi-layer molded article was produced. The total thickness of the skin material was decreased to 8 mm. In addition, a part of the foamed layer near an opening of the resin melt conduit was broken by the pressure and heat of the polypropylene resin melt for the article body.

The above conditions and the results are summarized in the following Table.

Table

Example No.	Body resin	Skin material	Blowing agent (amount)	Resin temp. (°C)	Mold temp. (°C) upper/lower	First step		Second step		
						Clearance at resin melt supply (mm)	Mold lowering rate (mm/sec)	Pressure (kg/cm^2)	Time (sec)
1	BPZ 5077	PVC sheet 0.6 mmt PP foam sheet (expansion rate of 15) 3 mmt	Cellmike MB 3062 (3 wt.%)	190	30/80	30	20	60	2
C. 1	〃	〃	None	〃	〃	〃	〃	〃	〃
2	AX 568	Tricot 2 mmt Polyurethane foam sheet (expansion rate of 16) 10 mmt	Cellmike MB 3013 (2 wt.%)	200	30/50	45	20	30	2
C. 2	〃	〃	None	〃	〃	〃	〃	〃	〃

Table (cont'd)

Example No.	Third step		Fourth step				Appearance of molded article
	Skin formation		Mold lifting distance (mm)	Mold lifting time (sec)	Pressure (kg/cm^2)	Time (sec)	
	Pressure (kg/cm^2)	Time (sec)					
1	60	5	3.0	30	10	30	Skin material side: good Body resin side: smooth and gloss, good
C. 2	↑	↑	↑	↑	↑	↑	No foaming of body resin Skin material side: unevenness
2	30	5	12	30	15	40	Skin material side: good Body resin side: smooth and gloss, good
C. 3	↑	↑	↑	↑	↑	↑	No foaming, skin material being thinned, Foamed layer near the conduit opening being broken

Claims

1. A method for producing a multi-layer molded article comprising a polypropylene resin body and a skin material lined with a foamed layer, which method comprises steps of:

providing a pair of upper and lower molds (1,2)

placing a skin material (7) lined with a foamed layer on said lower mold, the foamed layer contacting the surface of said lower mold

supplying a molten polypropylene resin and engaging said molds

the method being characterized by the steps of

providing a pair of upper and lower molds (1,2) which are slidably moveable at an engaged part (6) and in which a cavity clearance can be freely set

placing said skin material with a foamed layer supplying a molten polypropylene resin containing a chemical blowing agent through a resin melt conduit which is provided in said lower mold when said cavity clearance (t) is between (C + 15) mm and (C + 50) mm where "C" is the thickness of said skin material lined with the foamed layer,

lowering said upper mold (1) at a rate of from 10 mm/sec. to 100 mm/sec. and pressing said resin melt at a pressure of from 5 kg/cm^2 to 100 kg/cm^2 to fill the cavity ends with said resin melt to complete molding of a body of said resin,

pressing said body for 1 to 30 seconds after completing molding to form a skin layer at the part of the resin melt contacting the molds,

then, lifting up said upper mold 1 to decrease the compression pressure of said skin material lined with the foamed layer to a pressure lower than the blowing pressure of said polypropylene resin to blow the inner part of the resin melt mass to form and solidify a foamed body, and

again lowering said upper mold (1) to apply a pressure of from 1 kg/cm^2 to 20 kg/cm^2 on the molded article and cooling said article in said molds.

2. The method according to claim 1, wherein said propylene resin is a homopolymer of propylene.

3. The method according to claim 1, wherein said propylene resin is a copolymer of propylene with at least one other monomer.

Patentansprüche

1. Verfahren zur Herstellung eines mehrschichtigen geformten Gegenstandes, umfassend einen Polypropylenharzkörper und ein mit einer Schaumschicht kaschiertes Hautmaterial, welches Verfahren die Schritte:

Bereitstellen eines Paars aus einer oberen und einer unteren Form (1,2),

Einlegen eines mit einer Schaumschicht kaschierten Hautmaterials (7) in die untere Form, wobei die Schaumschicht die Oberfläche der unteren Form berührt,

Einfüllen eines geschmolzenen Polypropylenharzes und Verbinden der Formen umfaßt wobei das Verfahren gekennzeichnet ist durch die Schritte:

Bereitstellen eines Paars aus einer oberen und einer unteren Form (1,2), die an einer Verbindungsstelle (6) gegeneinander beweglich sind und in denen eine Hohlraumöffnung beliebig eingestellt werden kann,

Einlegen des Hautmaterials mit einer Schaumschicht,

Einfüllen eines geschmolzenen Polypropylenharzes, das ein chemisches Treibmittel enthält, durch einen Kanal für die Harzschmelze, der in der unteren Form zur Verfügung steht, wenn die Hohlraumöffnung (t) zwischen (C + 15) mm und (C + 50) mm beträgt, wobei "C" die Dicke des mit der Schaumschicht kaschierten Hautmaterials ist,

Absenken der oberen Form (1) mit einer Geschwindigkeit von 10 mm/sec. bis 100 mm/sec. und Pressen der Harzschmelze bei einem Druck von 5 kg/cm^2 bis 100 kg/cm^2, um die Hohlraumenden mit der Harzschmelze zu füllen, um die Ausformung eines Harzkörpers zu vervollständigen,

Pressen des Körpers während 1 bis 30 Sekunden nach der vollständigen Ausformung, um an dem Teil der Harzschmelze, der die Formen berührt, eine Hautschicht auszubilden,

dann Anheben der oberen Form (1), um den Kompressionsdruck des mit der Schaumschicht kaschierten Hautmaterials auf einen geringeren Druck als den Druck für das Aufblähen des Polypropylenharzes zu senken, um den inneren Teil der geschmolzenen Harzmasse aufzublähen, um einen Schaumkörper auszubilden und zu festigen und

wieder Absenken der oberen Form (1), um an den Formartikel einen Druck von 1 kg/cm^2 bis 20 kg/cm^2 anzulegen, und Abkühlen des Gegenstands in den Formen.

2. Verfahren nach Anspruch 1, wobei das Propylenharz ein Homopolymer von Propylen ist.

3. Verfahren nach Anspruch 1, wobei das Propylenharz ein Copolymer von Propylen mit mindestens einem weiteren Monomer ist.

Revendications

1. Procédé de production d'un article moulé multicouche comprenant un corps en résine de polypropylène et une peau doublée d'une couche expansée, lequel procédé comprend les étapes consistant à :
prévoir deux demi-moules supérieur et inférieur (1, 2)
placer une peau (7) doublée d'une couche expansée sur ledit demi-moule inférieur, la couche expansée étant en contact avec la surface du demi-moule inférieur,
introduire une résine de polypropylène fondue et emboîter les demi-moules,
le procédé étant caractérisé par les étapes consistant à :
prévoir deux demi-moules supérieur et inférieur (1, 2) déplaçables par coulissement au niveau d'une partie emboîtée (6) et pour lesquels on peut ajuster librement un écartement formant cavité
mettre en place ladite peau à couche expansée
introduire une résine de polypropylène fondue contenant un agent chimique gonflant par un conduit de résine fondue ménagé dans ledit demi-moule inférieur alors que ledit écartement formant cavité(t)est compris entre (C + 15) mm et (C + 50) mm, "C" étant l'épaisseur de ladite peau doublée de la couche expansée,
abaisser ledit demi-moule supérieur (1) à une vitesse comprise entre 10 mm/s à 100 mm/s et comprimer ladite résine fondue à une pression comprise entre 5 kg/cm^2 et 100 kg/cm^2 pour emplir les extrémités de la cavité de ladite résine fondue pour achever le moulage d'un corps en ladite résine,
comprimer ledit corps pendant 1 à 30 s après l'achèvement du moulage pour former une couche formant peau sur la partie de la résine fondue en contact avec les demi-moules,
puis relever ledit moule supérieur (1) pour abaisser la pression de compression s'exerçant sur ladite peau doublée de la couche expansée à un niveau inférieur à la pression de gonflement de ladite résine de polypropylène, pour gonfler la partie interne de la masse de résine fondue pour former et solidifier un corps expansé et
abaisser de nouveau ledit demi-moule supérieur (1) pour appliquer une pression comprise entre 1 kg/cm^2 et 20 kg/cm^2 sur l'article moulé et refroidir ledit article dans lesdits demi-moules.

2. Procédé selon la revendication 1, dans lequel ladite résine de propylène est un homopolymère de propylène.

3. Procédé selon la revendication 1, dans lequel ladite résine de propylène est un copolymère de propylène et d'au moins un autre monomère.

Fig. 1

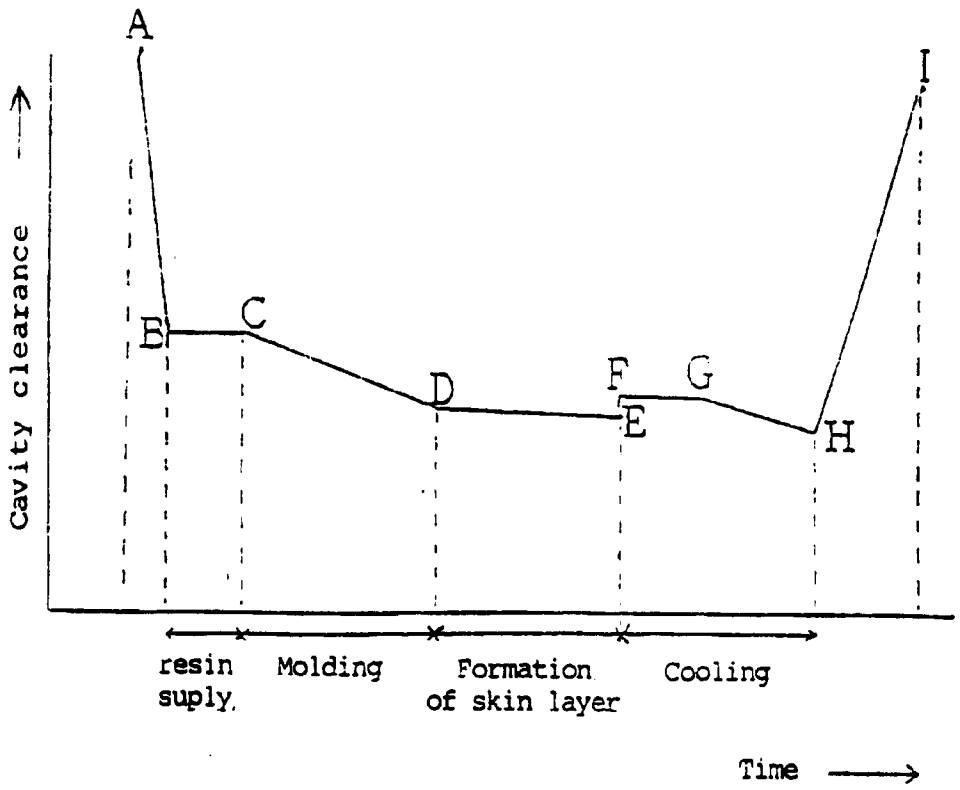
A
B
C
D
E
F
G
H
I
Cavity clearance
resin suply
Molding
Formation of skin layer
Cooling
Time

Fig. 6

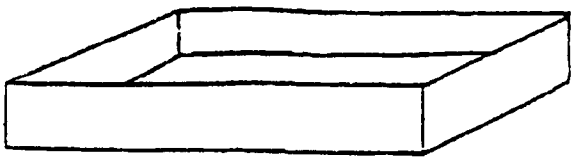

Fig. 2

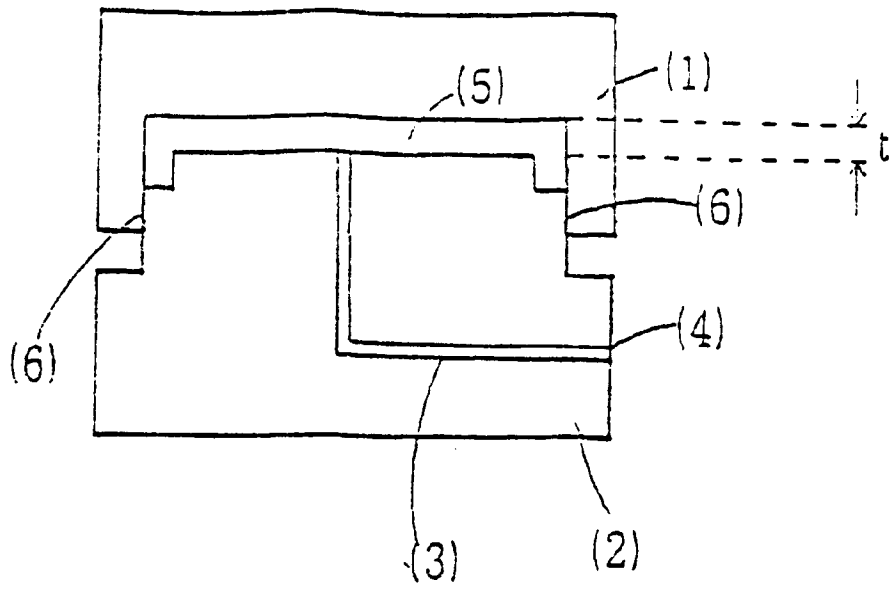

Fig. 3

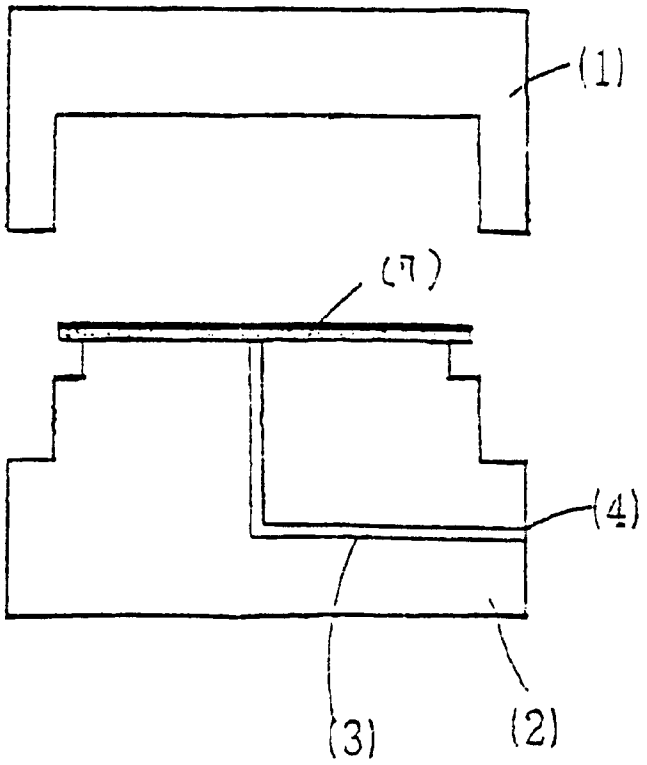

Fig. 4

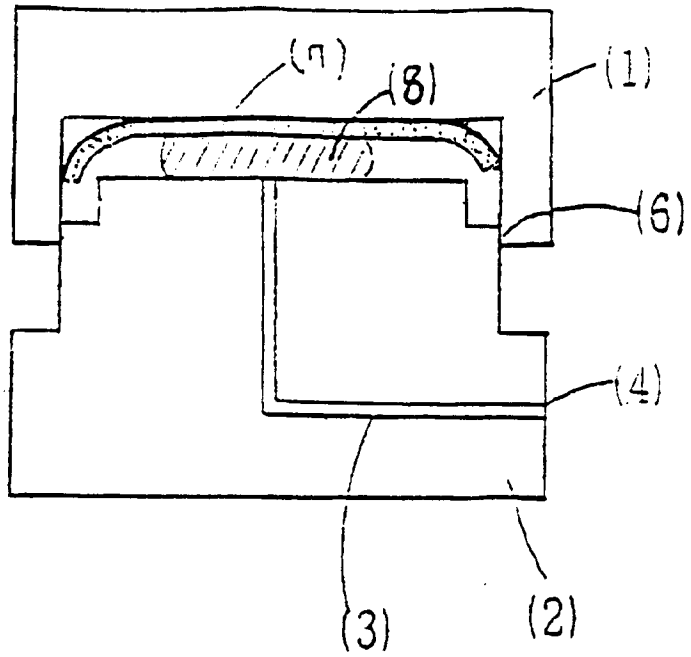

Fig. 5